This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

AS
W125
X

Wagner Free Institute of Science

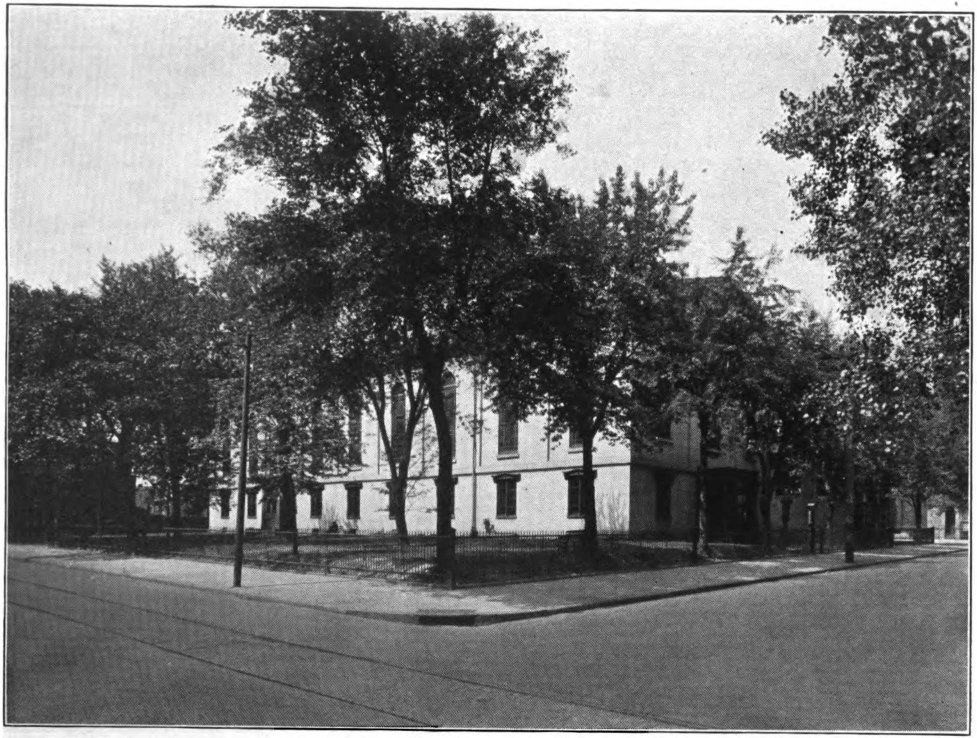
of Philadelphia

❖❖❖

Annual Announcement

1920-1921

WISCONSIN ACADEMY
OF
SCIENCES, ARTS AND LETTERS



THE WAGNER FREE INSTITUTE OF SCIENCE
Montgomery Ave. and Seventeenth St.

Wagner
Free Institute of Science
of Philadelphia

The Wagner Free Institute of Science
Montgomery Ave. and Seventeenth St.

ANNUAL ANNOUNCEMENT

Seventy-third Year

Philadelphia

1920

TRUSTEES.

President, Samuel Wagner.
Secretary, Sydney T. Skidmore.
Treasurer, J. Vaughan Merrick.
Samuel T. Wagner. Harrison S. Morris.
John Wagner, Jr.
Henry Leffmann, *Chairman*.

FACULTY.

William Healey Dall, A.M., Sc.D.
Honorary Professor of Invertebrate Paleontology.

Henry Leffmann, A.M., M.D., Ph.D.
Honorary Professor of Chemistry.

William B. Scott, A.M., Ph.D., LL.D.
Honorary Professor of Geology.

George F. Stradling, Ph.D.
Honorary Professor of Physics.

Samuel Tobias Wagner, B.S., C.E.
Professor of Engineering.

Spencer Trotter, M.D.
Professor of Zoölogy.

Samuel C. Schmucker, Ph.D., Sc.D.
Professor of Botany.

Leslie B. Seely, B.A.
Professor of Physics.

Charles H. LaWall, Ph.M.
Professor of Organic Chemistry.

David W. Horn, Ph.D.
Professor of Inorganic and Physical Chemistry.

Mayville W. Twitchell, Ph.D.
Professor of Geology.

John Wagner, Jr., B.S. in C.E. and C.E.
Lecturer in Engineering

John G. Rothermel, *Director*.

#6913462

Historical Note.

The Wagner Free Institute of Science owes its establishment to the liberality and public spirit of William Wagner and his wife, Louisa Binney Wagner. In his early life Professor Wagner made extensive voyages in the service of Stephen Girard, and had opportunities to visit scientific institutions and make the acquaintance of scientific workers. He soon developed a strong interest in the natural sciences, especially geology and mineralogy, and devoted a large part of his life to studying these topics and collecting material to illustrate the teaching of them.

In 1847 he began to give free lectures at his home, near the present location of the Institute building, at that time in the rural section of the county. In 1855 the Institute was incorporated by the Legislature, a faculty was appointed and lectures were given at Commissioners' Hall, Thirteenth and Spring Garden Streets, by permission of the city authorities. In a few years the city was obliged, by its own needs, to withdraw the privilege of the hall, and Professor Wagner arranged to erect a suitable building on his own property. This was completed in May, 1865, and lectures at once given in it. In 1864 a deed of trust was executed by Professor Wagner and his wife, furnishing a permanent endowment of the Institute.

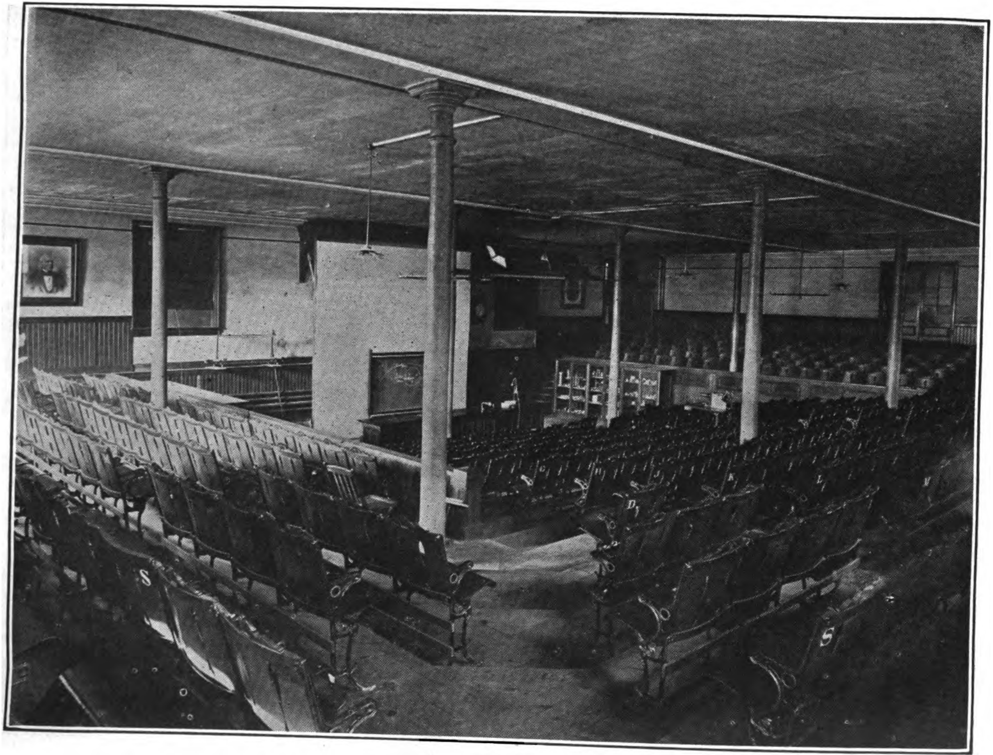
In 1885, by the death of the founder, the care of the Institute passed entirely into the hands of a Board of Trustees, and since then many improvements have been made in the building, and extensive additions to its equipment in the museum and library and in scientific apparatus. In 1901 a wing was built for the use of a branch of the Free Library of Philadelphia.

The lecture-room is capable of seating about six hundred persons and is equipped with excellent lecture facilities. The collection of physical apparatus comprises many of the older forms which have historic interest and a large number of the most recent invention and construction.

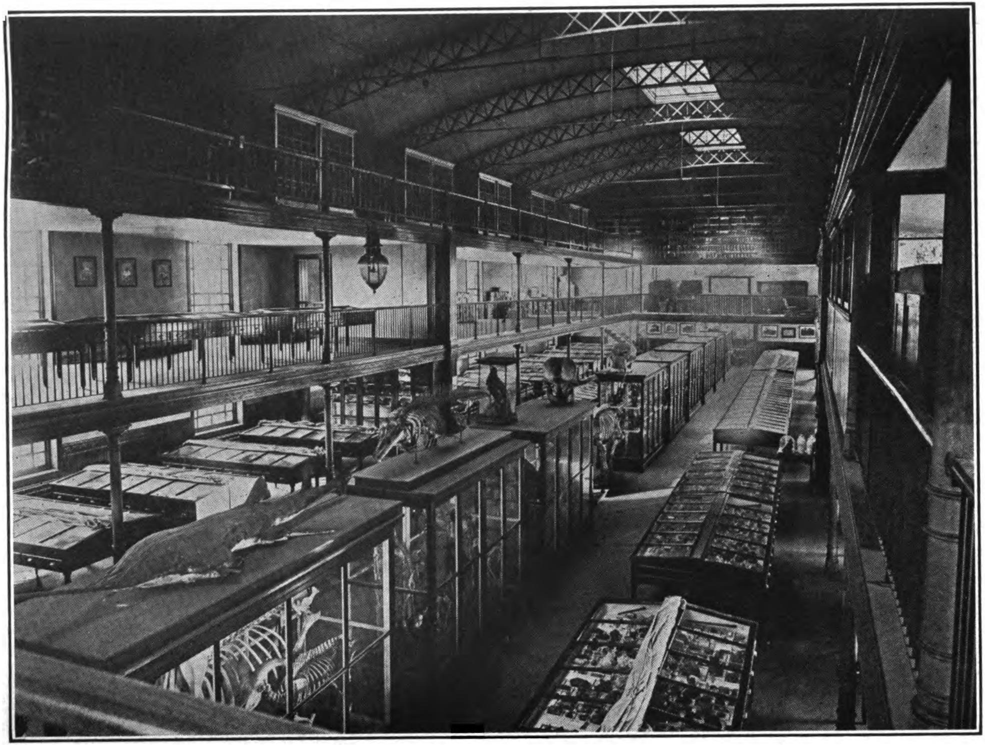
FACILITIES FOR INSTRUCTION.

LECTURES AND CLASS-WORK.

Instruction at the Wagner Free Institute of Science is conducted by means of public lectures, supplemented by class-work, and is without charge and without restriction of race or sex. The class-instruction is given partly



AUDITORIUM



Museum

at the close of each lecture, partly by written exercises. The museum and reference library of the Institute are available for aid in the instruction work and are freely used. In addition, the Wagner Free Institute Branch of the Free Library of Philadelphia affords abundant opportunities for collateral reading.

The lecture-hall is provided with the latest apparatus for lantern-slide, microscopic and opaque projection, and a high-class, non-inflammable film motion-picture machine.

At the close of each course of lectures an examination is held, to which those who have attended the classes are admitted, and on passing such examination the pupil is awarded a certificate. Certificates are awarded at a public meeting held in May of each year.

The lecture courses are arranged to cover a given topic in four successive years, and to those who hold certificates for each of these courses a full-term certificate is issued. (See pp. 25 and 26.)

MUSEUM.

The Museum covers the whole field of natural science and contains illustrations in all departments of biology, geology, mineralogy, metallurgy, and engineering. The specimens are arranged so as to be easily studied and are open to inspection from 2 to 5 o'clock Wednesday and Saturday afternoons, except legal holidays.

Teachers with classes and others desiring to use the museum for special studies can, however, by applying at the office, gain admission to it any week day, except holidays, as above stated, between the hours of 9 a. m. and 5 p. m.

The afternoon museum-talks, inaugurated six years ago, having been very successful, will be continued during the 1920–1921 season. The details of these talks will be announced as soon as the arrangements for them have been completed.

LIBRARIES.

The reference library contains text-books and works of reference in all departments of science, encyclopedias, many works devoted to literature and an assortment of dictionaries of English, classical and foreign languages. It is open on all regular business days from 9 a. m. to 9.30 p. m., a librarian being always in attendance to assist students.

The circulating library is a branch of the Free Library of Philadelphia. It is open every business day from 9 a. m. to 9 p. m. Books may be taken out under the usual rules of the Free Library. Many periodicals—American and foreign, scientific and literary—are on file.

ACCESSORY SCIENTIFIC WORK.

Three scientific societies meet at the Institute:

The *Philadelphia Natural History Society* on the third Thursday of each month, except June, July, and August.

The *Philadelphia Mineralogical Society* on the second Thursday of each month, except July and August.

The *Philadelphia Microscopical Society* on the fourth Thursday of each month except July and August.

These meetings are open to all persons.

SPECIAL LECTURES.

By the liberality of Richard Brodhead Westbrook, D.D., for many years a trustee of the Institute, and his wife, Henrietta Payne Westbrook, provision has been made for lectures independent of the general courses of the Institute and covering a wide range of topics.

Details of lectures already delivered under this foundation are given on page 29.

These lectures are being published by the Institute in book form. (See p. 28.)

The course for the 1920–1921 term is being arranged and will be announced in a special notice.

RESEARCH.

The Institute has maintained research work since 1885, and has published eight volumes and Part I of ninth volume of Transactions. A list of the subjects will be found on pages 27 and 28.

The income of a special fund is available for lectures and research in chemistry.

CLOSING EXERCISES.

In May of each year the courses of instruction are formally closed by a public meeting at which addresses are given and the certificates awarded.

At the closing exercises in May, 1920, after an address by Professor Samuel T. Wagner, President of the Faculty, and awarding of certificates (see p. 9), Dr. Clarence N. Fenner delivered an illustrated lecture on the "Katmai Volcano and the Valley of Ten Thousand Smokes."

FULL TERM CERTIFICATES AWARDED.

Engineering

R. C. Schlotterer

1919-1920 CERTIFICATES AWARDED.

Engineering, 1

James J. Deeney
Edward J. Dever
Arthur G. Eichelberger
Walter F. Estlack
Edward Frater
John I. Kelley
Jacob Liebman
Hugh F. Munro, Jr.
Milton K. Myers
Allen T. Quindlen
Dominic A. Siani

Inorganic Chemistry, 3

John Azentgraf
William S. Berry
Lewis Bokser
E. W. Crimbring
James J. Deeney
Robert Engel
H. E. Everding
Milton Feinberg
Alexander Finegold
J. Carrol Goodman
Jacob Greenberg
William H. Kelley
J. Kusner
John McIlvain
Catherine F. Moloney
Edward W. Rees
Margaret Schueder
Irvin I. Sofronski

Organic Chemistry, 3

James J. Deeney

Physics, 2

Arthur Eichelberger
Edward Frater
Walter F. Estlack
Daniel W. McIlravey
Allen T. Quindlen

Geology, 1

Arthur Eichelberger
Ralph Richter
Daniel W. McIlravey
John M. Root

Botany, 1

Clara J. Clair
Margaret S. Goodwin
E. Redowitz
Fred Lutz
John M. Root
Barbara H. Ruttle

REGULAR LECTURES
SESSION OF 1920–1921

ENGINEERING 2.
PROFESSOR SAMUEL T. WAGNER.

Lecturer—John Wagner, Jr., B.S. in C.E. and C.E.

Civil Engineering Structures.

Lectures begin at 8 p. m.

1. Friday, September 10.
   Foundations on Land. Designing the Footing. Preparation of the Bed.
2. Friday, September 17.
   Foundations on Land and Water. Foundations on Piles. Coffer Dams.
3. Friday, September 24.
   Foundations in Water. Open Caisson Process. Dredging through Wells. Pneumatic Caissons.
4. Friday, October 1.
   Masonry Construction. Stone Cutting. Preparation of Surfaces. Stone Masonry. Parts of a Wall.

5. Friday, October 8.
   Masonry Construction (Concluded). Ashlar. Rubble. Concrete. Brick Masonry. Retaining Walls, Piers, Etc.
6. Friday, October 15.
   Framing in Wood and Steel. Wood Framing. Iron and Steel Framing. Joints. Rivets. Pins.
7. Friday, October 22.
   Bridges. Definitions. Classification. History.
8. Friday, October 29.
   Bridges (Continued). History (Continued). Beam Bridges.
9. Friday, November 5.
   Bridges (Continued). Plate Girders. Trusses.
10. Friday, November 12.
    Bridges (Continued). Trusses (Continued). Classification. Design of Tension and Compression Members.
11. Friday, November 19.
    Bridges (Continued). Trusses (Concluded). Details and Methods of Erection. Cantilevers.
12. Friday, November 26.
    Bridges (Continued). Suspension. Tubular. Arches (a) Stone; (b) Steel.
13. Friday, December 3.
    Bridges (Concluded). Movable Bridges. Viaducts.
14. Friday, December 10.
    Roofs. Types of Trusses. Special Designs for Train Sheds.

15. Friday, December 17.
Details of Construction. Rivets, Riveted Work, Pins, Forging Details. Bridge Floors (a) Railroad; (b) Highway.

16. Friday, December 24.
Buildings. Design of Buildings of Wood, Steel, Reinforced Concrete, General Building Construction.

ZOÖLOGY 2.

PROFESSOR SPENCER TROTTER.

The Invertebrate Animals.

Lectures begin at 8 p. m.

1. Monday, October 18.
The Ocean World. Primitive Life and Its Environment. The Plankton. The Nekton. The Benthos. Origin of Forms. The Continental Shelf.

2. Monday, October 25.
The Phyla. Consideration of the Principles of Classification. Relations to Geological History.

3. Monday, November 1.
The Protozoa. Marine and Freshwater Forms. The Rhizopoda. The Mastigophora. The Infusoria. The Sporozoa.

4. Monday, November 8.

   Sponge, Polyp and *Medusa.* The Cœlenterate Type. Study of a Simple Sponge. Sponge Colonies. Law of the Division of Labor. Study of a Simple Polyp. The Medusa. Alternation of Generations. Individual and Organ. The Reef-building Corals. The Ctenophora. Stinging Cells.

5. Monday, November 15.

   Worms. Symmetry of Animal Body. Flat Worms. Life History of Tape Worm. Liver Fluke. Parasitism. Round Worms. Life History of Trichina. Earthworms and Leeches. Metamerism. Outlying Groups. Brachiopods. Polyzoa and Rotifers.

6. Monday, November 22.

   The Echinoderms. Study of a Starfish. The Sea Urchin. Holothurians and Crinoids. Radial Symmetry. Life Histories and Habits of Various Forms.

7. Monday, November 29.

   The Crustacea. Segments and Appendages. Study of Lobster. Life and Habits of Various Forms.

8. Monday, December 6.

   Insects. General Structure. Metamorphosis. Relation to Vegetation. Review of the Orders. Economic Relations of Various Forms.

9. Monday, December 13.

   The Mollusca. Study of a Clam. Review of the Orders. Life Histories and Habits of Various Forms.

10. Monday, December 20.
The Primitive Chordata. Tunicates. Balanoglossus. Ancestry of Vertebrates. Concluding Remarks on Course.

INORGANIC CHEMISTRY 4.

PROFESSOR DAVID WILBUR HORN.

Chemistry of the Metals.

Lectures begin at 8 p. m.

1. Tuesday, September 14.
Iron. Principal sources and methods of extraction. Statistics of production. Wrought iron, cast iron, and steel. Special steels.

2. Tuesday, September 21.
Iron (Continued). Compounds of iron. Distinction between ferrous and ferric salts. Methods of transformation. Biologic importance of iron.

3. Tuesday, September 28.
Copper. Sources and methods of extraction. Alloys. Important compounds.

4. Tuesday, October 5.
Lead. Sources and methods of extraction. Possible variability in atomic weight. Lead compounds. Importance of lead in industrial hygiene.

5. Tuesday, October 12.
Mercury. Sources, preparation, properties. Two series of salts. Industrial uses. Photosensitiveness of mercurous iodide.

6. Tuesday, October 19.
   Gold and Platinum. Occurrence, properties. Methods of gold mining. Industrial uses of gold and platinum.

7. Tuesday, October 26.
   Silver. Occurrence, properties. Methods of silver mining. Cupellation and parting. Photosensitiveness of silver salts. Use of silver in coinage.

8. Tuesday, November 2.
   Cobalt, Nickel, and Cadmium. Occurrence, preparation, properties and uses. Alloys. Metal-ammonia compounds. Principal and secondary valence.

9. Tuesday, November 9.
   Tin, Tungsten, and Titanium. Occurrence, preparation, properties. Industrial uses. Differences between tinned and "galvanized" iron. Tungsten in electric lighting.

10. Tuesday, November 16.
    Alloys and Amalgams. Physical chemistry of alloys. Metallography. Occlusion of gases by metals.

11. Tuesday, November 23.
    Bismuth, Molybdenum, and Uranium. Occurrence, preparation, properties. Bismuthyl and uranyl compounds. Industrial uses. Complex inorganic acids.

12. Tuesday, November 30.
    Rare and Radio-Active Metals. Transformation of metals. Modern alchemy. Niton and other emanations from metals.

ORGANIC CHEMISTRY 4.

PROFESSOR CHARLES H. LAWALL.

Compounds of Nitrogen and Allied Elements.

Lectures begin at 8 p. m.

1. Wednesday, September 15.

   Course limited to compounds in which nitrogen is not directly united to oxygen. Reasons for this distinction. Characteristics of the two types. The nitrogen cycle in biology. Allotropic nitrogen.

2. Wednesday, September 22.

   Open Chain Nitrogen Compounds. Cyanids, hydrocyanic acid, the dangers of hydrocyanic acid as an insecticide, complex cyanids, cyanates and isomers, nitroprussids, thiocyanates.

3. Wednesday, September 29.

   Open Chain Nitrogen Compounds (Continued). Amins and ammonium derivatives, phosphorus and arsenic analogs, azo- and diazo-compounds, dyes derived from these types, azoimid and hydrazoic acid.

4. Wednesday, October 6.

   Cyclic Nitrogen Compounds. Pyridin, quinolin, alkaloids. Color tests and adsorption experiments.

5. Wednesday, October 13.

   Food Poisoning. Ptomains and toxalbumins.

6. Wednesday, October 20.
Purins, Urea, Uric Acid, Xanthin, Caffein and Theobromin. Decaffeinated coffees, coffee substitutes.

7. Wednesday, October 27.
Proteins. Meaning and scope of the term. Distinction between albumin and albumen. General physical characteristics of proteins. Colloidal conditions.

8. Wednesday, November 3.
Proteins (Continued). Principal types. Present views as to structure. Amino-acids and polypeptids. Vitamins (so-called).

9. Wednesday, November 10.
Proteins (Continued). Transformations—coagulation, digestion and putrefaction. Peptoses, peptones. Important vegetable proteins.

10. Wednesday, November 17.
Proteins (Continued). Hemoglobin and chlorophyll. Enzyms or catalysts. General method of action of organic catalysts. Optimum conditions and promoters.

11. Wednesday, November 24.
Industrial casein, casein cements, cold water paints, bone substitutes, celluloid substitutes, casein in food stuffs.

12. Wednesday, December 1.
Industrial Gelatin and Albumin. Glue. Gelatin. Raw materials and process of manufacture. Fish glue, sizing, egg albumin, blood albumin, egg substitutes.

BOTANY 2.

PROFESSOR SAMUEL C. SCHMUCKER.

The Evolution of the Plant World.

Lectures begin at 8 p. m.

1. Monday, January 3.
   Plant Beginnings. (Algae.) Cells and cell partnerships. Sex and its beginnings.

2. Monday, January 10.
   Dependent Plants. (Fungi.) Bacteria; their help and their hindrance. Moulds and rusts, mushrooms and "toadstools."

3. Monday, January 17.
   A Plant Alliance. (Lichens.) Parasitism and Symbiosis.

4. Monday, January 24.
   Passing from the Water. (Bryophytes.) Liverworts and Mosses. The egg flask and the sperm sac.

5. Monday, January 31.
   Alternation of Generations. (Steridophytes.) The fern plant and its double life. The sexual generation; the asexual generation. Spores.

6. Monday, February 7.
   The Fern's Near Kin. (Horsetails and Groundpines.) The trees of the coal age.

7. Monday, February 14.
   The Early Seed Plants. (Pteridosperms and Gymnosperms.) Pines and other cone bearers. Our modern forests.

8. Monday, February 21.

The Higher Seed Plants. (Angiosperms.) The modern flower and its parts, needful and helpful. The great work of seeds.

9. Monday, February 28.

Lilies to Palms. (Monocotyledons.) Lilies, grasses, orchids and palms.

10. Monday, March 7.

The Crown of the Plant World. (Dicotyledons.) Willows to Daisies. The parallel evolution of insects. Success in the plant world.

PHYSICS 3.

PROFESSOR LESLIE B. SEELY.

Light.

Lectures begin at 8 p. m.

1. Friday, January 7.

Historical. History of the Development of the Theory of Light. The Impingement Theory of Light. Newton. Huygens. The Ether Wave Theory. Galileo. Rumford. Electro-Magnetic Theory of Light.

2. Friday, January 14.

Propagation of Light. Light travels in Straight Lines. Intensity of Light. Law of Inverse Squares. Shadows.

3. Friday, January 21.

Propagation of Light (Continued). Brightness and Illumination. Photometry. Speed of Light.

4. Friday, January 28.
   Reflection. Law of Reflection. Mirrors and Diffusing Surfaces. Plane Mirrors.

5. Friday, February 4.
   Reflection (Continued). Curved Mirrors. Principal Focus, Conjugate Foci and Center of Curvature. Images: Real and Apparent.

6. Friday, February 11.
   Refraction. Passage of Light to Denser and to Rarer Media. Index of Refraction. The Angle of Total Reflection.

7. Friday, February 18.
   Refraction (Continued). Lenses and Prisms. Principal Focus and Conjugate Foci of Lenses. Images by Lenses.

8. Friday, February 25.
   Dispersion. Composition of White Light. Complementary Colors. Pigments.

9. Friday, March 4.
   Color Phenomena. Coloration by Absorption and Reflection. Opalescence. Phosphorescence. Fluorescence.

10. Friday, March 11.
    Spectra. The Solar Spectrum. Fraunhofer's Lines. Bright Line and Dark Line Spectra. The Spectroscope.

11. Friday, March 18.
    Spectra (Continued). Infra-red and Ultraviolet Light. Composition of the Sun's Energy. Artificial Lights and Sunlight.

12. Friday, April 1.
    Interference and Polarization. Description of Interference Phenomena. Polarization.

13. Friday, April 8.
Optical Instruments. Magnifying Glass. Compound Microscope. Telescope.

14. Friday, April 15.
Optical Instruments (Continued). The Projecting Lantern. Opaque Projection. Stereoscope. Binocular Vision.

15. Friday, April 22.
Photography. The Camera Obscura. The Photographic Process. Lens Correction. Color Photography.

16. Friday, April 29.
The Eye and Common Defects of Vision. Near-sightedness and Far-sightedness. Astigmatism. Color Blindness.

GEOLOGY 2.

PROFESSOR MAYVILLE W. TWITCHELL.

Geologic Processes and the Making of Scenery.

Lectures begin at 8 p. m.
The lectures will be illustrated by lantern slides.

1. Tuesday, January 4.
Fantastic Scenery due to the Work of the Air. The first attack on the rocks. Rock-splitting and rock-decay. Plant and animal aid in the work of rock-destruction. From rocks to soils. Landslides and sand dunes. Mushroom scenery.

2. Tuesday, January 11.
Rains, Storms and Floods. The work of the rain. Storm movements. The weather service. Curious effects of rain erosion.

3. Tuesday, January 18.

Waterfalls and Gorges. Running water as the greatest of earth-sculptors. Wearing down the rocks and carrying away the débris. Causes of waterfalls. Accidents to streams. Special features of valleys. Gems of river and valley scenery. Cones, fans, terraces, and flood plains.

4. Tuesday, January 25.

Seashore Scenery. The carving work of the waves. A flank attack on the rocks. Cliffs, arches, caves and other scenic gems of the shore. Terraces, spits and bars. Lagoons and changing shore lines. Deep sea deposits.

5. Tuesday, February 1.

Glaciers and Glacial Scenery. The formation, surface features and movements of glaciers. Rock-wear due to glacial action. Avalanches, crevasses and icebergs, Moraines and glacial boulders. Some famous glaciers.

6. Tuesday, February 8.

Cavern Scenery. The work of underground water. Dissolving the rocks and carrying away the resulting materials. Stalactites and Stalagmites. Cavern life. Some famous caves.

7. Tuesday, February 15.

Geysers and Hot Springs. The mystery of geyser action. The Yellowstone Park and other geyser fields. Beautiful hot-spring terraces.

8. Tuesday, March 1.

Coral Reefs and Coal Forests. The coral polyp and its habits. Coral islands. Peat bogs and coal plants. Rock formation by organic accumulation.

9. Tuesday, March 8.

The Beauties of Lake Scenery. The origin and life-history of lakes. Famous lakes in many lands.

10. Tuesday, March 15.

The Rise of the Continents. How giant forces cause oscillations of the Earth's crust. Evidences of elevation and depression. The curious theory of isostasy. The elevation of coastal plains and high interior plateaus.

11. Tuesday, March 22.

The Birth of the Mountain Ranges. Why mountain ranges are formed near sea coasts. Rock-wrinkling due to giant forces. The internal architecture of mountain systems. Some remarkable experiments.

12. Tuesday, March 29.

Volcanoes and Great Volcanic Eruptions. The interior heat of the Earth. Causes of volcanoes. Explosive and non-explosive types. The phenomena of an eruption. Rock-making by volcanic action. The life history of a volcano.

13. Tuesday, April 5.

Lava Floods and Igneous Intrusions. The phenomena of fissure eruptions. The effects on the rocks of igneous intrusions. Metamorphism as a geologic process. The great lava field of the Northwest.

14. Tuesday, April 12.

Earthquakes and their Effects. Causes. Volcanic and fault-slip types. Geological effects. Effects on the works of man. Some great earthquakes of history.

15. Tuesday, April 19.

Our Greatest Scenery: Grand Canyons. How the elevating and wearing-down forces combine in the case of plateaus and produce wonderful scenic effects. The Grand Canyon of the Colorado.

16. Tuesday, April 26.

Our Greatest Scenery: Mountain Peaks. How the elevating and wearing-down forces combine to modify the mountains into gems of scenic beauty. The Matterhorn and other famous peaks.

GENERAL SCHEDULE OF REGULAR LECTURES.

Subjects of courses in each of the four successive years constituting a full term.

ENGINEERING.

1. Materials of Engineering Construction.
2. Civil Engineering Structures.
3. Roads, Railroads and Tunnels.
4. Water-supply, Sewers, Canals, Rivers and Harbors.

INORGANIC CHEMISTRY.

1. General Principles, Notation, Nomenclature.
2. Descriptive Chemistry.
3. Descriptive Chemistry.
4. Descriptive Chemistry.

ORGANIC CHEMISTRY.

1. General Principles. Aliphatic hydrocarbons.
2. Carbohydrates. Fats, oils and waxes.
3. Cyclic hydrocarbons.
4. Compounds containing nitrogen.

ZOÖLOGY.

1. Phenomena of Animal Life.
2. Invertebrate Animals.
3. Vertebrate Animals.
4. The Human Mechanism.

BOTANY.

1. The Life of the Plant.
2. Plant Evolution.
3. The Great Families of Flowering Plants.
4. Ecologic and Economic Botany.

PHYSICS.

1. Properties of Matter. Mechanics.
2. Sound and Heat.
3. Light.
4. Electricity and Magnetism.

GEOLOGY.

1. Geologic Materials.
2. Geologic Processes.
3. Geologic History.
4. Applied Geology.

PUBLICATIONS OF THE INSTITUTE.

TRANSACTIONS.

Vol. 1.—Explorations on the West Coast of Florida and in the Okeechobee Wilderness.
Angelo Heilprin.

Vol. 2.—Report on Fresh-water Sponges Collected in Florida. *Edward Potts.*

Notice of Some Fossil Human Bones.
Joseph Leidy.

Description of Mammalian Remains from Rock Crevice in Florida. *Joseph Leidy.*

Description of Vertebrate Remains from Peace Creek, Florida. *Joseph Leidy.*

Notice of Some Mammalian Remains from Salt Mine of Petite Anse, Louisiana.
Joseph Leidy.

On Platygonus, an Extinct Genus Allied to the Peccaries. *Joseph Leidy.*

Remarks on the Nature of Organic Species.
Joseph Leidy.

Vol. 3.—Parts 1, 2, 3, 4, 5, 6.—Contributions to the Tertiary Fauna of Florida. *William H. Dall.*

Vol. 4.—Fossil Vertebrates from the Alachua Clays, Florida. *Joseph Leidy.*

Vol. 5.—Study of Hawaiian Skulls. *Harrison Allen.*
Notes on the Palæontological Publications of Prof. William Wagner. *William H. Dall.*

Vol. 6.—Selenodont Artiodactyls of the Uinta Eocene.
William B. Scott.

Vol. 7.—Contributions to the Mineralogy of the Newark Group in Pennsylvania. *Edgar T. Wherry.*
A Comparative Study of the Radio-Active Minerals in the Collection of the Wagner Free Institute of Science.
Carl Boyer and Edgar T. Wherry.
Vegetation of South Florida.
John W. Harshberger.

(*Under Department of Chemistry Endowment*)
Studies in Carbohydrates.
Charles H. LaWall and Sara S. Graves.

Vol. 8.—Special Lectures by the Teaching Staff of the Institute. (*Under Westbrook Free Lectureship.*)

Vol. 9.—Part I. The Vegetation of the Hackensack Marsh: A Typical American Fen.
John W. Harshberger and Vincent G. Burns.

Republication of Conrad's Fossils of the Medial Tertiary of the United States. Introduction by *William H. Dall.*

WESTBROOK FREE LECTURESHIP PUBLICATIONS.

Ancient Civilization of Babylonia and Assyria, by *Morris Jastrow, Jr., Ph.D.*

The Theory of Evolution, by *William Berryman Scott, Ph.D., LL.D.*

Life and Death, Heredity and Evolution in Unicellular Organisms, by *H. S. Jennings, Ph.D., LL.D.*

LECTURES UNDER RICHARD B. WESTBROOK FOUNDATION.

1912.—Ancient Civilization of Babylonia and Assyria. *Morris Jastrow, Jr., Ph.D.*

1913.—Conservation of Natural Resources. *Gifford Pinchot, Marshall O. Leighton, Overton W. Price, Joseph A. Holmes.*

1914.—The Theory of Evolution. *William Berryman Scott, Ph.D., LL.D.*

1915.—Invisible Light. *Robert Williams Wood, LL.D.*

1916.—Aspects of Modern Astronomy. *John Anthony Miller, A.B., A.M., Ph.D.*

1917.—Heredity and Evolution in the Simplest Organisms. *H. S. Jennings, B.S., A.M., Ph.D., LL.D.*

1918.—The Chemistry, Nutritive Value and Economy of Foods. *Harvey W. Wiley, A.M., M.D., B.S., Ph.D., LL.D., D.Sc.*

1919.—The Origin and Antiquity of the American Indian. *Aleš Hrdlička.*

1920.—Chemistry and Civilization. *Allerton S. Cushman, B.S., A.M., Ph.D.*

ANNOUNCEMENT.

The details of the Course for 1921 will be announced later.

89094309655

b89094309655a